10 'Human-centred' computing: a new perspective?

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Prologue

I first met Niels Bjørn-Andersen when we were both on the International Programme Committee for an EU Conference on the Information Society chaired by Enid Mumford (Bjørn-Andersen et al., 1982). In 1985, I met him again, this time in California at one of the early human–computer interaction conferences (ACM CHI), and then I spent a period at the Copenhagen Business School with his group that summer, before my travels in Asia. On my return, I again spent a month with Niels Bjørn-Andersen at the CBS in January 1988, where we produced a paper for one of the earliest workshops on CSCW in Europe (Bannon et al., 1988). I had heard Niels Bjørn-Andersen give a talk with the provocative title: 'Are human factors "human"?' (subsequently published as Bjørn-Andersen, 1985) that resonated with my experiences in the human factors field. My work since that time has increasingly come to question the adequacy of our understanding of the human aspect of computing, and the following continues this concern.

Introduction

This chapter discusses the emergence of a more 'human-centred' approach to computing from a rather personal point of view. I would argue that there is a significant paradigm shift in the computing field towards this human-centred approach that has been slowly gathering momentum over the past quarter century, and is now beginning to move from the periphery of the computing field to a more central role. The issues at stake here are, in my view, substantive and may have profound implications for what and how we teach students about computing in the coming years. Thus it is not simply the need to (occasionally) talk about issues of computers and society – often the label of a lightweight course that has been added almost as an afterthought in many computing departments – nor simply the need to incorporate courses relating to the

user interface and human–computer interaction. Rather, what is involved is a radical rethinking of the computing field, and a shift in emphasis from aspects of the hardware and software to aspects of the human, social and organizational contexts within which information and communication technologies are both being constituted and used. In this chapter I mention some of the people who have led the way towards a more encompassing view of computing, but focus more on my own personal odyssey in attempting to understand computing as a human activity, and the possible implications for how we design and use information systems, and how we conceptualize 'computing' more generally.

The pioneers

Many people have been involved in the attempt to shift the focus of computing – and informatics more generally – away from a purely technical approach concerned with hardware and software only, to one that considers the human activities of design and use of information systems as being of central concern. Many of these people have come from the Nordic countries. People such as the late Kristen Nygaard, who argued for a perspective on systems development that included the social and political, as well as the technical. People like Peter Naur, whose compilation of papers was published under the title 'Computing: A Human Activity', and which showed terrific insight into the human side of programming and systems development. People like Christiane Floyd, from Germany, who presciently wrote of different paradigms in software engineering. In the US, the late Rob Kling spent many years as an advocate of a more open computer science (CS) discipline he labelled 'Social Informatics'. More recently, a number of senior figures in the field have put their hats in the ring: Bo Dahlbom, with his paper on 'The New Informatics'; Peter Denning, of the US, arguing for a new and more expansive computing profession; Denis Tsichritzis, critiquing much old-fashioned computer science as being akin to 'electric motor' science; Peter Wegner, arguing that interaction is more powerful than algorithms; and Terry Winograd, one of a number of people involved in bringing the larger field of design into computing. All of these authors, despite significant differences in their messages, share a critique of how the field of computing and the academic discipline of computer science has been defined, circumscribed, and taught to students, and all advocate a more 'human-centred' approach, in one form or another. In reflecting on our educational system, Denning (1992) notes: 'A curriculum capable of preparing students for the shifting world must incorporate new elements emphasising design, demonstrated proficiency, effective interaction with others, and a greater sensitivity toward the historical and cultural spaces in which we all live and work.'

The issue here is not simply providing computer science students with a rounded education, but more fundamentally questions the very nature of the discipline, arguing that human activities and interests are part of the core of the computing discipline, whenever we conceptualize, design, build, and test new technologies.

This alternative view of computing has led to the slow emergence of what is beginning to be termed, in some quarters, 'human-centred' computing. The label may appear somewhat meaningless, as who would subscribe to an alternative 'system-centred' computing label, but, just as the label 'user-centred design' in the field of human–computer interaction hit a chord in the 1980s, it may be the case that the 'human-centred computing' label will have a similar re-orienting effect on the field of computing in the early 2000s. Likewise with other new terms that are appearing currently. Concerns expressed in such emerging areas as the 'new informatics', and 'interaction design' are, in my opinion, examples of shifts in perspective, in the information systems and human–computer interaction communities respectively, towards a more wholistic view of human–systems interaction that begins to privilege the human, social and cultural aspects of computing. Note that these are not simply surface changes, nor should they be viewed simply as ancillary issues in relation to the dominant computational approach, but rather they raise foundational issues for the field of computing *per se*. The reasons for this shift in perspective are, I believe, many and varied, with some impetus coming from the very nature of the new technologies themselves, e.g ubiquitous computing. This chapter is not the place to provide a detailed and densely argued case for the evolution and definition of this new perspective.[1] Rather, in what follows, I will provide a personal view on this new perspective, showing some of the topics that it would need to grapple with in a more substantive fashion than heretofore, based on my own research path over the years.

A human activity-centred view of computing

My personal perspective on computing is one that views the technology from a tool, or sometimes a mediator, perspective. This approach focuses on understanding human activity, from a variety of perspectives, all of which seek to provide useful and pertinent observations on human action in the world. What is common among this work is a highlighting of the user perspective, examining how people accomplish their goals – with and through other people, and at times, other media. While technology may play an important role in these human activities, often

1. I am currently engaged in writing just such an article. A recent book covers aspects of this perspective shift (Dourish, 2001).

the use of the technology is as an intrinsic mediating influence, rather than being the goal of the activity. The relevance of this approach to technology development is that it provides a distinct perspective that encompasses many of the key issues being faced by computing technology developers today – issues such as *awareness*, *context*, *interaction*, *engagement*, *emotion*. All of these aspects concern the activities of human actors in a (variety of) setting(s). I have been involved, over the years, in extending the design boundaries of HCI (Bannon, 1985; 1986a,b,c), grappling with issues of context and with alternative frames for theorizing about human–computer interaction (Bannon, 1990, 1991; Bannon and Kaptelinin, 2000) developing our understanding of cooperative work in CSCW (Bannon and Bødker, 1991; Bannon and Schmidt, 1991; Schmidt and Bannon, 1992), understanding the role of work practices in organizational learning and memory (Bannon, 1998; Bannon and Kuutti, 2002), and more recently, in working on a framework to understand the field of interaction design, dealing with issues of meaning, engagement and emotion (Aboulafia et al., 2001). What might appear to be somewhat unrelated topics, taken from one perspective, can be seen to be integrated from another.

This perspective is one that takes the term 'human-centred' to mean more than simply 'considering the user' in technology development, but rather places our understanding of people and their practices to the forefront in the design of new technology. The issue here is not simply one of values, although explication of the underlying values inherent in technological designs is certainly important, but requires us to understand human activity in the world. This perspective is inspired by a number of theoretical perspectives, including phenomenology. Applying phenomenological methodology (and hermeneutics) to design was suggested by Winograd and Flores (1986), whose work has had a significant influence on the development of recent 'human-centred' approaches to computing. Moran and Anderson (1990) have proposed as a specific paradigm for design, the Workaday World, which 'puts the technology in proper perspective', the perspective of the lifeworld (*lebenswelt*) of people working. This paradigm, also motivated by phenomenology, draws on the works of such figures as Husserl, Habermas, Heidegger, Schutz and Luckmann. The notion of 'lifeworld' is defined as the sphere of practical activity and commonsense reasoning (derived from Husserl). It is a description, from the view of a particular 'actor', which captures the experience of that actor, involving three aspects: technology, social relationship, and work practice. Ehn's (1988) notion of 'work-oriented design' within the participative design tradition also draws on this phenomenological account. Ehn argues that a Heideggerian approach to design creates a new understanding of the process of designing computer artefacts that 'help focus on the importance of everydayness of use as fundamental to design'. The

Scandinavian work on participatory design in systems development – from the late 1970s onwards has had a significant influence in 'opening up' the computing and more general information systems fields to aspects of human activities relating to the design and use of technology.

Another of the major conceptual frameworks that we have found helpful in developing our understanding of certain computer-related issues, specifically in human–computer interaction, is what is commonly termed (cultural–historical) activity theory. This framework shifts attention away from the interface *per se* and focuses on computer-mediated activity. We believe that this shift in focus is extremely important if we are to develop truly useful and usable systems that support people in their everyday activities. The framework emphasizes the concept of mediation in all human activities, and its strongly historical approach provides us with a powerful tool for viewing the computer system as yet another, albeit much more powerful and flexible mediational device that is used by people to accomplish certain goals. While the conceptual framework can be at times obscure, it provides a useful conceptual tool for understanding such issues as user goals, mediational means, work context or environment, and collective human activities. What is of interest in this approach is a more theoretical framing of certain issues which are difficult to conceptualize within, for example, traditional information-processing accounts of human behaviour. For example, the problem of context, which has become more and more recognized as a crucial issue for useful theory and empirical work, is built into the very basis of the theory, in terms of activities. 'An activity system comprises the individual practitioner, the colleagues and co-workers of the workplace community, the conceptual and practical tools, and the shared objects as a unified dynamic whole' (Engeström, 1991). The conceptual framework of activity theory can be presented as a set of underlying principles. The basic principles of the approach include: object-orientedness, internalization/externalization, tool mediation, hierarchical structure of activity, and development (Bannon and Kaptelinin, 2000).

In our own HCI work over the years, we have attempted at both a theoretical and practical level to improve the accessibility, usability and utility of technology for people. We have emphasized the importance of viewing the computer as a medium through which people interact, and not simply as a calculator or even a tool (Bannon, 1986c). We have emphasized the fact that people are attempting to accomplish an activity through computers, and not simply 'using the computer' as an end in itself. Thus the issue is not improving instruction for computer users, but making more effective tools and media that help people in different walks of life accomplish their goals. Thus, the problems people have with computers are seen not as a lack of 'computer knowledge' but a failure of designers to understand the nature of the work and the work

setting. We prefer to speak of 'computer-mediated activity' rather than 'human–computer interaction' for the same reason. Our work has contributed in the shift from a system-centred to a user-centred design process (Norman, 1986). We have also emphasized the importance of participatory design practices as a way of ensuring that the designs we develop truly meet the needs of people (Bannon, 1990). We also highlight the importance of studying use as a prelude to design (Bannon and Bødker, 1991). We study use throughout the design cycle, through developing mock-ups and scenarios of future use that allow people to experience the future use situation, and then again, in developing early prototypes of systems that can be tested, so that the results of these tests can be fed back into the design process in order to improve the system (Grønbæk et al., 1993).

The situation today

The focus on human activities mediated by technologies throws up a number of issues for further exploration. While issues such as 'context' and 'awareness' have been discussed in different research communities for many years, including such interdisciplinary communities as HCI and CSCW, it has only been in the past five years, with the emergence of the ubiquitous or pervasive computing field, that such topics appear to have 'leaped the divide' and become respectable topics to be discussed in more mainstream computing and communications technology research. Unfortunately, the fact that certain topics have now become legitimate does not imply that the understanding of the topic has progressively deepened. Thus 'context' often becomes reified, and reduced to a 'thing' which can then be explicated in terms of a small set of parameters, such as roles or settings. Personally, and playing devil's advocate here, I do not feel that this kind of approach to 'context' will get us very far. From a more activity-centred viewpoint, one would argue that 'context' is not something that is somehow 'fixed' and 'out there', but rather is itself partially a construction of particular actors in particular settings. This is important, in that it raises questions as to how one can develop mechanisms that will automatically determine relevance and context, if these are concepts that are difficult to formally define.

If we look at the field of CSCW, the focus has been on cooperative work arrangements that emerge as a result of the nature of the actual work being performed. Thus there is an emphasis on field studies in specific work domains. While traditional task and work analysis methods from work psychology and sociology can contribute here, much interest has centred on more qualitative, interpretive, ethnographic studies of work practices in an effort to understand more

fully the 'artful practices' of ensembles of workers as they accomplish their work activities. While more traditional sociological and anthropological concepts – division of labour, issues of power and control, symbolism, etc. – are of importance to CSCW, there has been particular interest in ethnographic studies, chiefly of an ethnomethodological nature (Button, 1993). This perspective is distinct from earlier critiques of neo-Taylorist management approaches, such as that of Braverman and the labour process school, in its emphasis on the detailed observation and understanding of the mundane practicalities of 'getting the work done'. The emphasis in these studies is on the work that members do in order to make their work accountable to themselves and each other, focusing on the 'working division of labour' (Anderson et al., 1989) as distinct from viewing the division of labour as an analytical category. This work seems of particular relevance to designers of CSCW systems, where lack of attention to such matters as how the work is actually accomplished by members of the working community has led at times to the development of systems that fail dramatically (Harper et al., 1991).

It is my belief that much of the contribution of the past 15 years of research in the CSCW community has been to clarify our understandings of many mundane, and seemingly well-understood terms such as 'procedure', 'awareness', 'routine work', 'training', 'situated action' etc. Note that this is not simply a terminological exercise, but has huge importance for the kind of technological research agenda that will offer results that are acceptable to the end user population. Thus, many of the ethnographic, workplace studies performed in CSCW have provided very useful resources for the development of more appropriate design scenarios. The anthropologist Pat Sachs draws on both general ethnographic and activity theoretic backgrounds for her perspective on work (Sachs, 1994). Her critique builds on that of figures such as Wynn, Suchman, Blomberg, Orr, Scribner, Hutchins, and herself and others on the nature and organization of everyday work practices. This body of work, through critical argumentation and extensive field work, has begun to have an impact on a number of fields – including management studies, business administration, information systems development, organizational behaviour, job design, human resource management, training, etc. This increasingly prominent view reconceptualizes the nature of work and organizational life, and the role of information technology support. It emphasizes work practices, and the way learning is accomplished within communities of practice. It argues that learning and action are 'situated' (Suchman, 1987), and that work is accomplished via artefacts, in conjunction with others. Much of this work has helped to shape the field of CSCW (Schmidt and Bannon, 1992). Sachs (1994) argues passionately and cogently for the need to reconceptualize the nature of

work, away from what she terms an 'organizational' view, to one she labels 'activity-oriented'. To synopsize these perspectives the organizational view is still the predominant one in organizations today, grounded in scientific management ideas, focusing on training, tasks, procedures, workflow and teams, in contrast to the activity-oriented view focusing on learning, know-how, networks, conceptual understanding, work practices, judgement, and communities (of practice).

The contrast is between the 'documented, visible and articulatable' versus the tacit, silent and 'only-understood-by-the group'. Understanding business process needs to be informed by business practices on the shopfloor, as detailed in Chapter 4 of Brown and Duguid's book, *The Social Life of Information* (Brown and Duguid, 2000) entitled 'Practice Makes Process'. They note the distinction between the concepts embodied in process models and workflow representations versus the tacit, implicit, embodied and unarticulated knowledge inherent in work practices, and point to the importance of the concept of 'communities of practice' (Lave and Wenger, 1991) – the basic social unit in which work gets done and in which these skills are shared, learned, and evolved. As Sachs notes: 'Because the people who design business processes are ordinarily not the individuals who do the hands-on work, and because business process designers tend to think organizationally rather than employing work thinking, the fund of knowledge about details of work process are generally not incorporated into work process designs. (Sachs, 1994).

A look into the future

Despite the rhetoric concerning the Information Society and the scenarios of Ambient Intelligence, what is remarkable is how little human beings have changed their goals, aspirations and even activities over the past half-century. New technologies are appropriated to fit into these more enduring concerns, of working, learning, meeting friends, searching for meaning in our lives. We need a rich understanding of the human, social and cultural world in order to design technological artefacts and environments that people find useful, usable and engaging. We should learn from the failures of certain kinds of proactive, technology-push, applications. People do not want to be inundated with 'information'. Their needs change depending on the situation they are in, so it is difficult to satisfy their needs simply by means of personal profiles or adaptive systems. Again, playing devil's advocate, I would strongly urge that developers explore design spaces that do not assume advances in machine intelligence, nor detailed user models. Computers can work on behavioural data, and reflect this back

to people, without needing to 'interpret' its meaning. The interpretation of information should be left in the human realm, what computers can do admirably is collate and present information in a myriad of ways. This is in strong contrast to much of the Ambient Intelligence approach, which appears to smuggle many traditional Artificial Intelligence ideas back into the world of ubiquitous computing, despite the failure of the earlier AI approaches in attempting to model human intentions and behaviour.

As I have indicated throughout this chapter, it is my belief that there needs to be significant research work to provide more integrated conceptual frames for understanding human activity in the world, which can serve as an inspiration and motivation for developing design scenarios involving 'ubiquitous technology' that can in turn orient technological developments. While there is significant work in mobile technologies, one of the few areas where Europe has a lead, much of the work within the ubiquitous computing paradigm appears to lack any clear motivation, in terms of augmenting practical human activities. We need to develop alternative design frames that go beyond such concepts as 'the intelligent home', which almost invariably seem to be led by technological fantasies. In Europe, we have a strong philosophical, sociological and anthropological research tradition that should be able to make a significant contribution to the articulation of more realistic scenarios for life in the future than those derived purely from technological fetishism. We are beginning to see the emergence of an approach to technology that is informed by an understanding of our social and cultural world. This can be seen in our developing understanding of how work gets done, of the importance of human networks, of how knowledge is not viewed simply as a thing to be delivered, of what motivates people. We need to build on this understanding, rather than ignore it.

Concluding remarks

In this chapter I have noted the emergence of a new perspective on computing – human-centred computing – that views computing within a broader frame of human, social and cultural activities. I have outlined my own personal interest in this topic over the years, and other developments that I feel are important to the understanding of this emerging paradigm. My interest in understanding human activities mediated by technology has spanned a number of years and topics, as noted earlier. Early work focused on individual activities (e.g. Bannon et al., 1983), and more recent work examines behavioural aspects of human activities in public spaces (e.g. Ciolfi and Bannon, 2002). The relevance of this paradigm for implementing successful ubiquitous

computing environments is beginning to be recognized, with a growth of interest in activity-centred computing, as distinct from application-centred, or document-centred, computing paradigms (see, for example, Christensen and Bardram, 2002). I see the articulation of this activity-based frame for ubiquitous computing as being a major objective for work in my research group, and a substantial contribution towards an alternative ubiquitous computing development paradigm. This work will merge creative exploration of the possibilities of new technologies, in terms, for example, of new physical interfaces and multimodal capacities, with a clear design focus that starts out with issues of relevance for our society today. We are designing computationally enhanced artefacts and environments, from a human-activity theoretical perspective, and testing and prototyping them in a variety of work and play spaces. I, and my team in the Interaction Design Centre at the University of Limerick, passionately believe in creating a future that, while exploiting the innovative nature of the new technologies, is also rooted in a background and understanding and that is sensitive to, and builds on, our unique cultural traditions, and on our human values. We attempt to link these concerns in our work on emerging computing paradigms through our focus on human activities, and on the way they may be enhanced, supported and transcended with, by, and through novel interactive forms. Our design ideas have been influenced by several core themes that we have attempted to incorporate in our design thinking. Listing them briefly here, these are:

- *Human activity* – as a fundamental aspect of human being in the world
- *Materiality of objects* – the central role of material artefacts in human culture
- *Engagement* – the need to excite, motivate, enhance the user experience
- *Interaction* – human play with objects being seen as a narrative activity, not as simple action-reaction (mouse event–action pairs)
- *Multimodality* – incorporating several sensory modalities – visual, tactual, kinaesthetic, sonic, auditory
- *Sociality* – creating artefacts or assemblies of artefacts that allow for collaborative activity
- *Augmentation* – viewing the computer as a medium or tool for human actions, not as an intelligent butler or agent that attempts to model us.

I believe that, in Europe especially, we have a real opportunity to develop a distinct approach to the emerging field of 'human-centred computing'. This is because of its history and cultural diversity, and its rich tradition in several fields, including anthropology and design, which I believe will play an increasingly important role in further technological developments. The recent formation of the EU *Convivio* Network, the network for human-centred interactive design, is just one more indicator of this trend towards a truly 'human-centred' computing.